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UNITED STATES
DEPARTMENT OF AGRICULTURE

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BREAD *or* BARBERRIES

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DON'T LET IT LIVE NEAR ENOUGH
TO THROTTLE YOUR WHEAT.

U. S. GOVERNMENT PRINTING OFFICE: 1928

THE COMMON BARBERRY bush has been known to man for more than 2,000 years. For years men looked upon the common barberry as a friend, but to-day it is known to be an enemy.

It starts and spreads the enormously destructive black stem rust of wheat, oats, barley, rye, and many grasses.

Every year black stem rust destroys millions of bushels of wheat, oats, barley, and rye. Some years this disease is so severe that some crops are not worth harvesting.

When the crops are rusted there is less feed for our animals, less wheat for milling, and less bread for us all.

Stem rust starts each spring as tiny, yellowish spots on the leaves of the common barberry. Each of these spots produces thousands of spores, which are carried by the winds to the grain plants and start the rust on them. The rust takes the food from the grain plants, making them weak and sick and unable to produce big, plump kernels.

In 1918 the United States Department of Agriculture, in cooperation with the 13 States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming, began a campaign to destroy every common barberry bush in these States. Millions of bushes have been found and killed, but millions still remain to spread destruction to the grain crops.

Because these bushes are difficult to find, and because boys and girls have such keen eyes and love to roam through fields and woods and along streams where barberries may be growing, the United States Department of Agriculture is asking every boy and girl to help in this great fight against the common barberry.

Washington, D. C. **January, 1928**

BREAD OR BARBERRIES

By Edith M. Patch

Collaborator, United States Department of Agriculture, and Entomologist, Maine Agricultural Experiment Station

A PLANT WITH TWO HOMES

SWALLOWS and many other birds live in warm countries in the winter and then fly to the north where they build their nests and bring up their young in the summer. Salmon and eels and some other fishes live part of the time in the salt sea water and part of the time in fresh-water streams and ponds. There are kinds of insects that stay for a while on the leaves of trees and live during the rest of the year on the roots of plants in the ground.

These birds and fishes and insects are not the only living things that have a habit of leaving one kind of home and moving to another when they need a change. Some plants spend part of their lives in one place and part in another and altogether different sort of home. One kind of plant lives for a while each year on barberry bushes and the rest of the time on plants belonging to the grass family, such as wheat, oats, barley, and rye, and many other grasses. The plant that does this is one kind of fungus.

A FUNGUS

Perhaps the kind of fungus you know best you call a toadstool because it is shaped like a little stool and is about the right size for a toad. If you cut off the top of a toadstool and place it on a piece of paper, the paper under it will soon be covered with something that looks like the finest sort of dust. The dustlike particles are called spores, and, although they are very tiny, they contain life, as seeds do, and they can grow into toadstools.

If you kick a kind of fungus that is called a puffball, the spores, if they are ripe, come puffing out in a dark cloud and are blown about by the wind. Such of these spores as fall in the right sort of place germinate and grow into puffballs.

The fungus that lives part of the time on the common barberry bushes and part of the time on wheat or other plants of the grass family has one kind of spores that are reddish like the color of iron rust. For that reason it is called a rust. A rust is a queer sort of plant that has different stages in its life and each stage has ways and habits of its own.

These stages in the life of the rust are (1) the colorless stage, (2) the yellow or cluster-cup stage, (3) the red or summer stage, and (4) the black or winter stage.

THE LIFE STORY OF A RUST

In the spring, when plants begin to grow, there is a little visitor that comes and makes itself at home on a barberry leaf. This tiny visitor is a rust spore of the first stage of stem rust. This spore, like many more of its kind, has just been produced by the black spores of the rust which have rested through the winter on stubble and old straw. (Fig. 1.)

This tiny spore rests on the leaf and takes a bath in a raindrop or in dew. When it has soaked for a few hours it sprouts, and a little rootlike tube called a *hypha* pushes out of it and reaches into the barberry leaf. It sucks food out of the inside of the leaf, and grows into a rust plant. In order to be healthy the barberry leaf needs this food for itself. So, while the rust plant is growing strong, the barberry leaf becomes weak and sick.

Such a starved, sick barberry leaf soon has a yellowish spot on top and some little yellowish cup-shaped growths on the underside. This is the second stage of the rust. These growths lie close together in clusters and are called cluster cups. (Fig. 2.) They are filled with yellow spores that grow in rows like beads in a chain. When they are ripe these spores are shot out into the air like smoke from a gun, and the wind lifts and carries them as it does smoke.

The spores that are shot out of the cluster cups can not grow on a barberry leaf. This seems very strange, as the barberry leaf has the right sort of food for the cluster cups themselves.

The habit of these yellow spores that come out of the cluster cups is to live on plants that belong to the grass family, and not on any other kind. Such of the spores as are blown to barberry bushes or oak trees or potatoes or anything in the world except some kind of grass can not grow into rust plants, but die while they are spores. But there are thousands and thousands of spores that, in tiny clouds, come puffing out of the cluster cups, and many of them are brought to wild or cultivated grasses. If there are any wheat plants growing in the neighborhood of a barberry bush, they are sure to be dusted with spores that are blown over from the cluster cups.

When one of these spores comes to rest on a wheat stem or leaf, and soaks for four or five hours in a drop of rain or dew, it starts to grow. It sends out a little tube or hypha that grows along the outside of the stem until it comes to a breathing pore. Then it grows into the pore, and helps itself to the food in the inside of the wheat plant. Of course the wheat plant needs this food, and, if there are many rust plants growing on it and stealing its food, it becomes weak and sick. After a spore starts its hypha into the wheat it takes about a week or 10 days for the fungus to grow into a rust plant old enough to produce more ripe spores. These spores grow in little spots called *pustules*.

A sick wheat plant soon looks as if it had little blisterlike pustules all over its body—on its stems and leaves. In a few days these pustules open. They are filled with ripe spores which are rusty red in color. (Fig. 3.) This is the third stage of stem rust and is known as the red stage.

These red spores blow to other wheat plants, and the same thing happens. So, about once every 10 days, there is a fresh crop of red spores ready to blow from sick, rusty wheat to healthy wheat, which in turn becomes rusty and weak. Before the wheat ripens there may not be a single healthy wheat plant in the whole field.

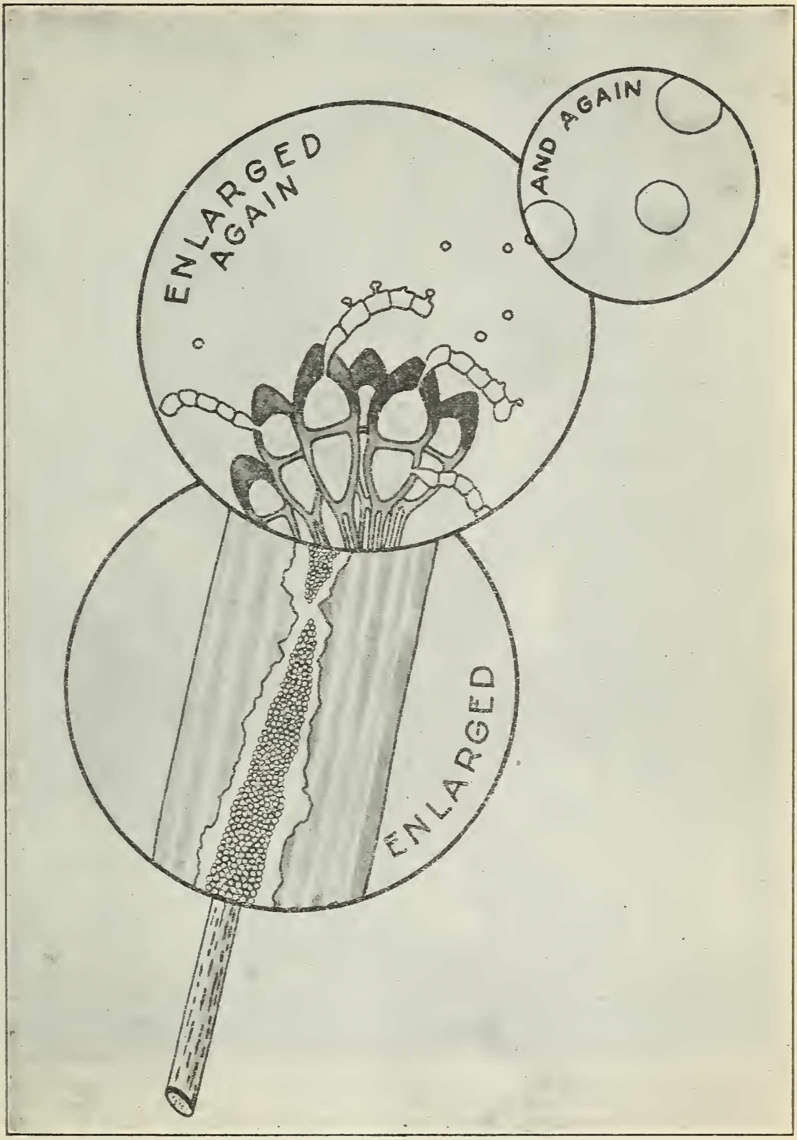

FIG. 1.—A piece of wheat straw with pustules filled with black spores which have lived through the winter. The middle circle shows how these black spores produce the transparent spores which cause rust on the barberry

Instead of having big, plump kernels as healthy wheat plants do, the sick plants have shrunken grain that is not fit for making flour. Thus the rust steals our bread by making the wheat plant too weak to have good seeds.

You now know about three stages of the rust—the colorless stage which is produced by the black stage, the yellow cluster-cup stage on barberry leaves in the spring, and the red stage on wheat (or other grains or grasses) in the summer. After the red stage, there comes a fourth or black stage.

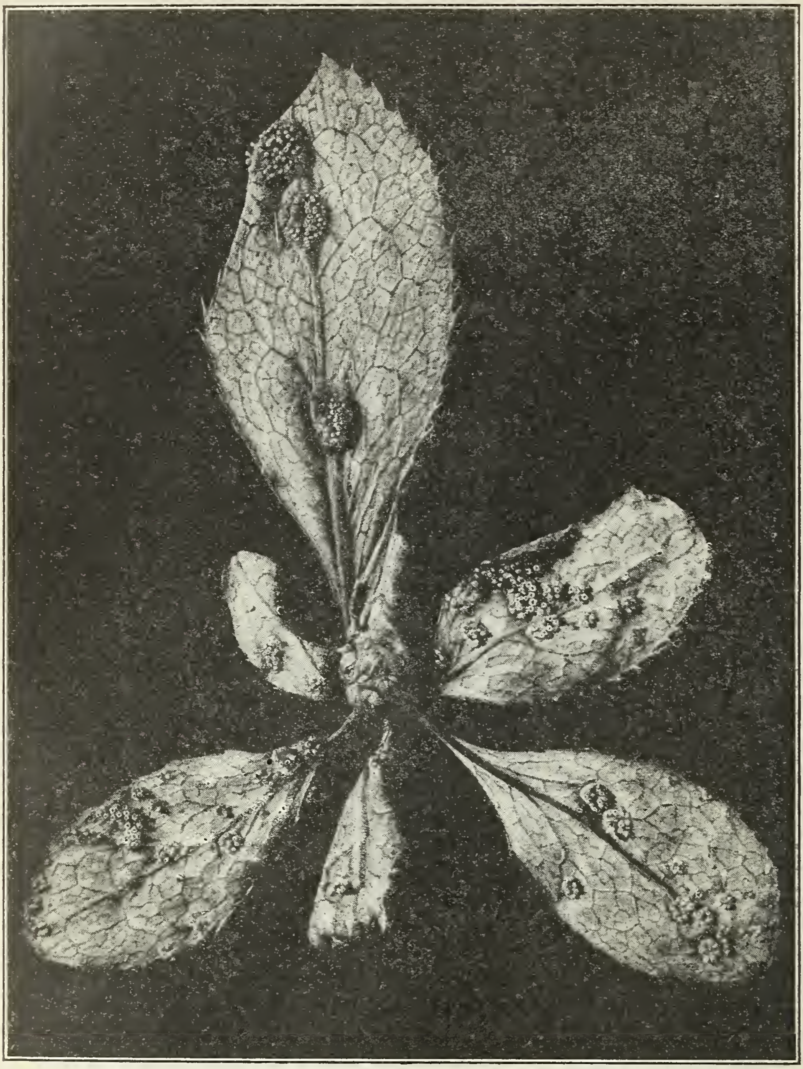

FIG. 2.—In the spring the rust forms groups of cluster cups on the leaves of the common barberry. These cluster cups are filled with thousands of spores which are carried by the winds to wheat and other grains or to grasses

As the grain begins to ripen, pustules filled with black spores appear. (Fig. 4.) Because of these black pustules the rust then is called black stem rust, although it is the same rust.

The black spores stay quiet and unchanged all through the fall and winter in the pustules on the dry stems of wheat and other grasses. They sometimes are called resting spores because of this habit.

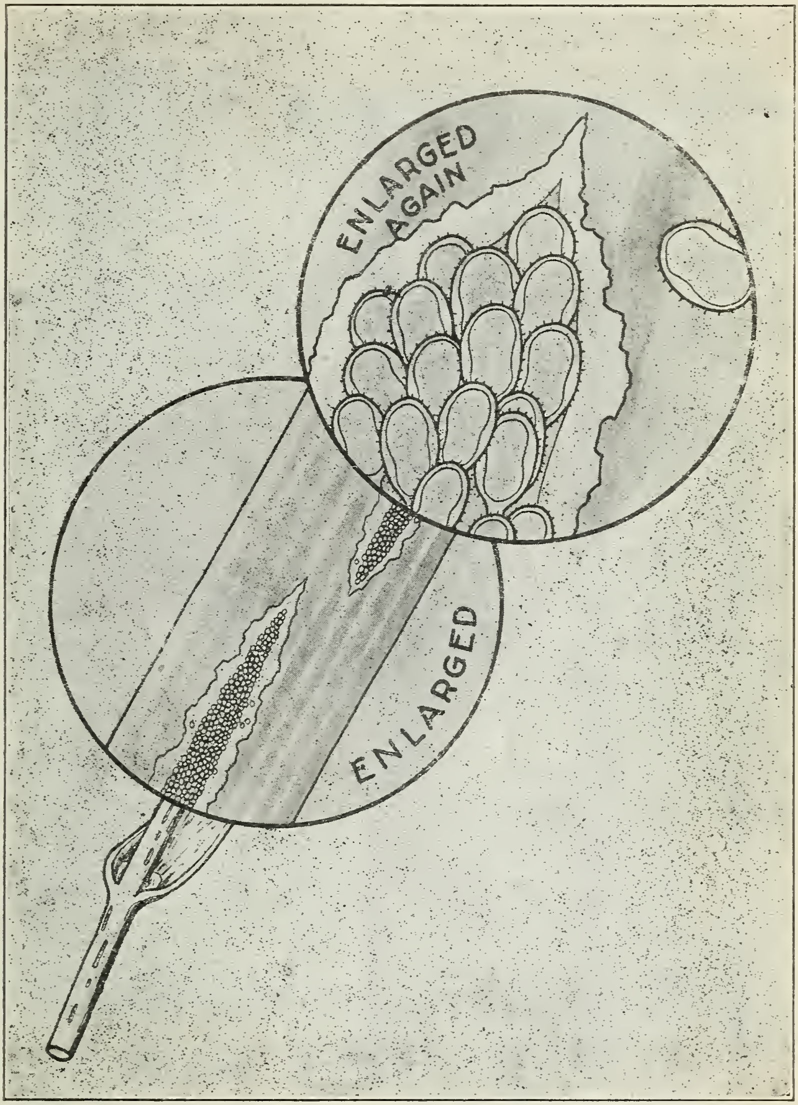

FIG. 3.—A piece of wheat stem with red rust pustules. The lower circle shows parts of two pustules enlarged. In the upper circle a few of the red or summer spores which fill these pustules are greatly magnified

In the spring, when the soaking rains come, the black spores swell. Each cell of a black spore then pushes out a slender white thread or hypha. Each hypha bears only four spores. (Fig. 1.) These are so few and so tiny and colorless that they are not seen by the naked eye. These bring us again to the first stage of the stem rust. Although tiny and nearly invisible, these spores are a most important link in the life of the rust. For it is in this stage that the rust leaves the dry, dead wheat stem and finds its way, by the help of the wind or any chance breeze, to a fresh new barberry leaf in the spring. There it settles and, sending its hypha or tube into the leaf, takes for itself the food that is inside. Thus it grows until it forms the cluster cups we talked about before.

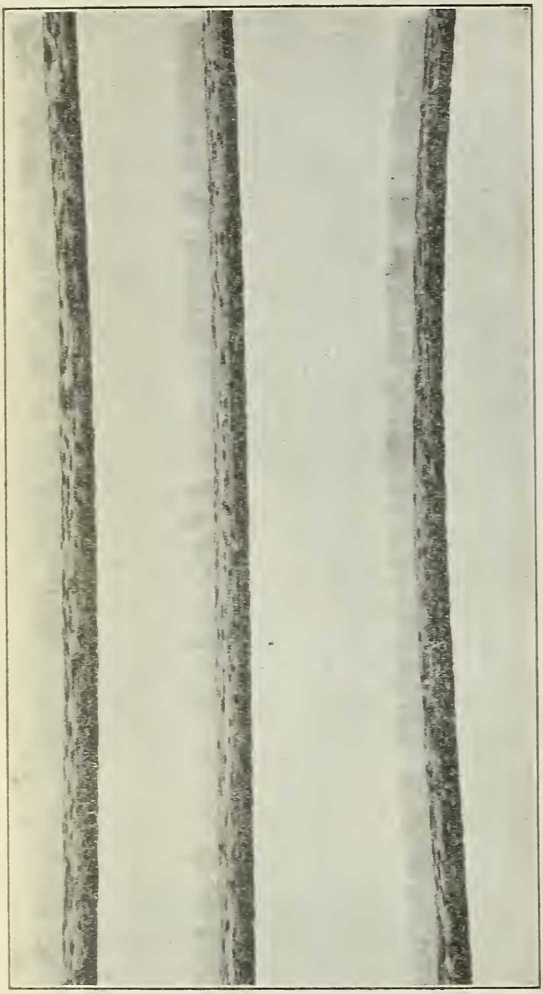

FIG. 4.—As the grain begins to ripen, the rust pustules become filled with black spores

THE COMMON BARBERRY

The common barberry (fig. 5) has been so interesting to people that something is known of its history for more than 2,000 years. For many centuries people liked to have the barberry growing in their yards and gardens and fields. When they moved they took seeds or young bushes with them to their new homes. Travelers carried the seeds from country to country. Men looked upon the barberry as a friend.

Nowadays people who understand what sort of neighbor the barberry is do not wish to see it growing. Instead of cherishing it, they kill it. In many places they make laws which forbid the planting of this bush and laws to provide for getting rid of it in places where it is growing. They look upon the barberry as an enemy.

The history of the barberry in different places helps us to understand both the old-time and the present-day feeling about this shrub.

The common barberry still lives wild among the mountains in Asia. We know that it was growing in that part of the world more than 2,500 years ago because of what the old Hindu writers wrote about it. In those days doctors used parts of the barberry in making medicine. Indeed, it seems to have been because of its use in medicine that the barberry was brought out of Asia into countries where it had not grown before. Little by little this bush was taken into all the countries of Europe. In most of these countries doctors used to steep barberry leaves or bark or roots and give this old-fashioned medicine to people who were sick.

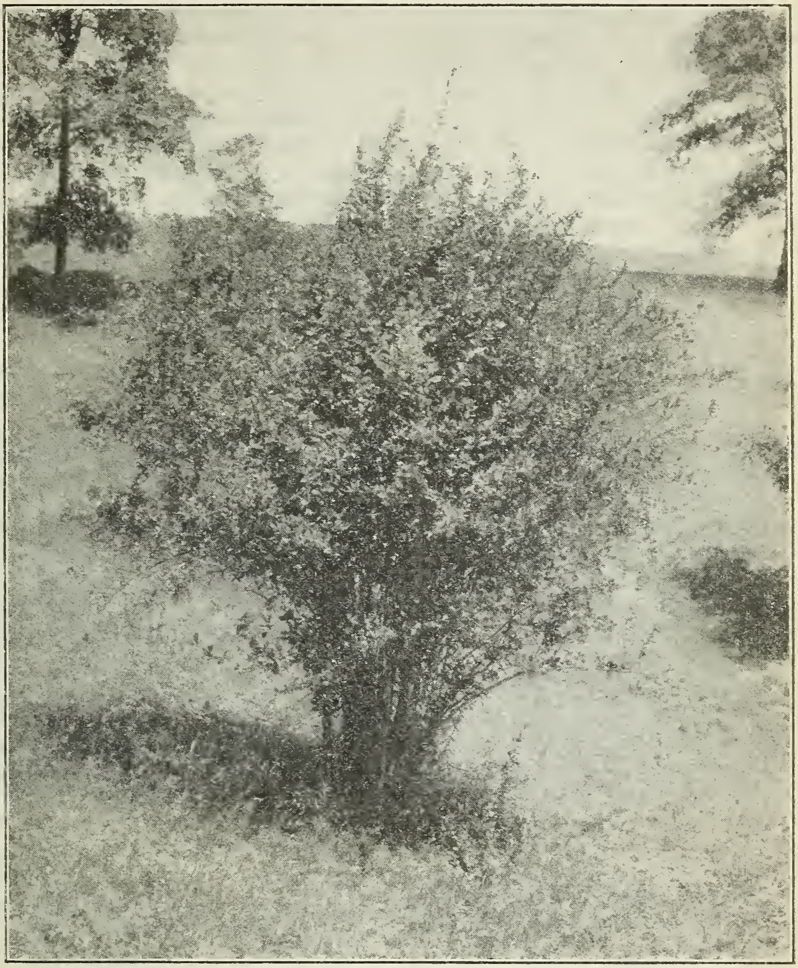

FIG. 5.—A bush of common barberry. It spreads stem rust to wheat and other grains. Report every one to your State agricultural college

Once people made their own dyes and inks. From the inner bark of the barberry they made yellow dye. By adding certain materials to this dye they made green dye. They found that by treating the juice from the barberry plant with alum they could make red ink.

The wood of common barberry is strong, and in the old days men used it in making certain small articles such as teeth for rakes.

The tender leaves in spring are sour, and some people ate them for salad, as sorrel leaves have sometimes been used. The sour juice of the fruit was pressed out and used in many ways, as lemon juice is now used, for flavoring some kinds of drinks and foods. It was used also for making vinegar. The fruit, cooked with molasses or sugar, made jam and jelly. It is no hardship now to spare the barberry from our tables, because there is plenty of other fruit for jelly and jam and vinegar, and there are such agreeable drinks as lemonade and grape juice and raspberry shrub.

Long ago, in the days before the first wire fences were made, when farmers wished to separate one field from another, they planted hedges. Of all the bushes they used in this way, the barberry was the favorite because the many stems made a thick hedge, and the thorns kept men and animals from breaking through. It was many years before farmers learned why their grain crops did not grow well near such hedges.

The barberry was pleasant to look at. The poet Lowell wrote:

> All down the loose-walled lanes in archin' bowers
> The barb'ry droops its strings o' golden flowers.

It was not in springtime only that people enjoyed the barberry. The bunches of red berries were attractive when they were ripe, and so were the autumn colors of the leaves. Such beauty, however, belonged only to a healthy bush. A barberry sick with rust and covered with cluster cups was not a pretty sight.

So we find that there have been, at one time and another, several reasons for liking the barberry bush. Some of these reasons explain why people who came to America from England and Germany and Sweden brought the barberry with them and planted it in a land where it had never grown before. In the same way, people moving westward from New England took the barberry with them to other parts of the United States.

The one big important reason for considering the barberry an enemy overshadows all the little reasons there once were for considering it a friend. This reason is that, in the great northern wheat regions of this country, the common barberry is the plant from which the black stem rust spreads to grasses and grains, including wheat.

After a deed has been done, it often is easy to look back and say whether it was well to do it. We know now that it was a terrible mistake to bring such a pest as the barberry to America. Even after it had been planted in New England, it should have been killed instead of being carried westward. This mistake that was made is costing our country great fortunes every year, for the barberry (because it scatters the spores of the destructive rust) is the worst enemy of our most important food crop—wheat.

WHEAT IS IN DANGER

Wheat has been grown as a grain crop for more than 5,000 years, perhaps for more than 10,000 years. Who or where the people were who first sowed wheat in little gardens no one knows, because it was so long ago. But there are reasons to think that the first large wheat farms may have been in Asia on fertile land between the Tigris and the Euphrates Rivers. On the ancient tombs in Egypt there are pictures which show how people sowed wheat about 6,000 years ago.

There is a story that the first wheat seeds sown in America were a few grains which one of Cortez's slaves found mixed with some rice which had been brought from Spain. It is said that all the wheat crops of Mexico started from the seeds saved and grown by that one careful slave about 400 years ago.

In the United States the first wheat is thought to have been sown on the Elizabeth Islands off the coast of Massachusetts about three and a quarter centuries ago. Later wheat was grown in Virginia. George Washington owned what were in his time the largest wheat fields in America, and there was no better flour made in the world than the Mount Vernon brand.

For many good reasons wheat always has been a pioneer crop. It grows well on new land. It can be carried great distances and kept for a long time without spoiling. Millions of people need it for food, so it is easy to sell it. As families moved westward from New England into New York and Ohio and then farther on to Wisconsin, Minnesota, and other parts of the Middle West, wheat often was the first crop grown after the land was plowed. Later wheat was sown on the newly broken land in the Pacific Coast States. Over much of this great area wheat still is the most important crop. (Fig. 6.)

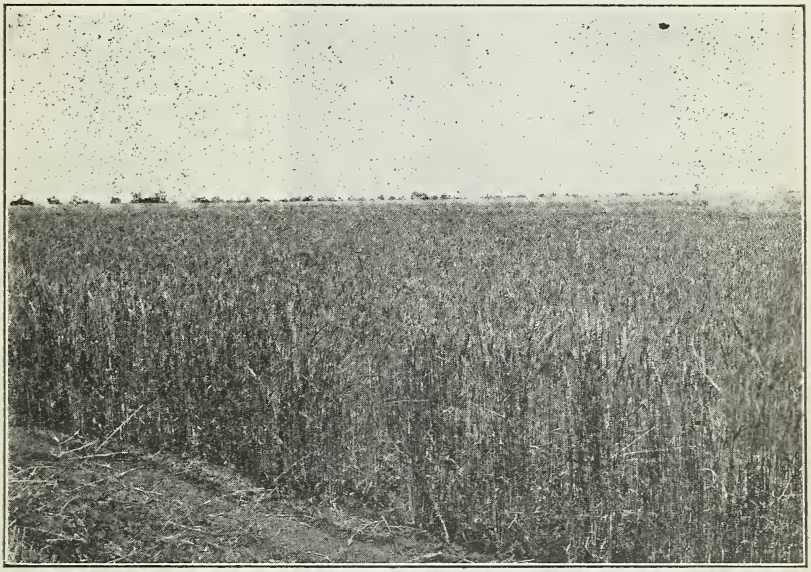

Fig. 6.—A field of wheat that has not been rusted. This is the kind of wheat our millers need in order to make good flour

For the people who grow wheat there is much toil and cost and anxiety. The labor of plowing and cultivating the ground, the task of sowing the seed, the long weeks of waiting while the wheat grows, the uncertainty about weather conditions—all these experiences must come before there is a chance for a harvest.

It is not strange, therefore, that when the grain is ripe men rejoice to hear the noise of the reapers or binders or the combined harvester-thresher giant moving across the great western wheat farms. Some of these marvelous machines, as the name harvester-thresher suggests, cut the grain and thresh it at the same time, pouring the clean wheat into sacks or wagons. Such a machine, drawn through the field by as many as 32 horses or a giant tractor, can cut and sack the grain from 50 acres in a day.

To see one of these monsters move its dusty way across a field of grain, to watch the steady march of a binder through a field of golden wheat, is to take one's thoughts a long way from the swish of scythes and the beating of flails—the tools of harvesting and threshing of the long ago.

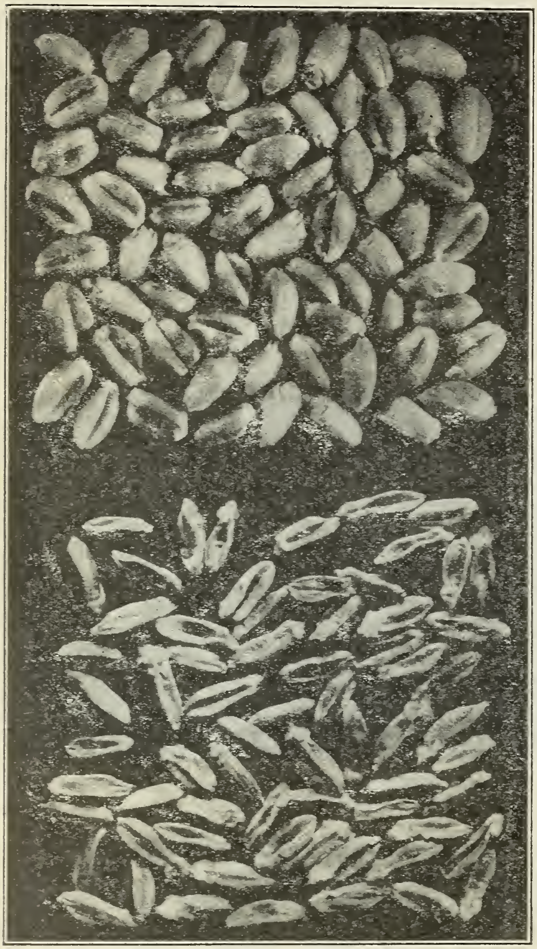

FIG. 7.—The shriveled wheat kernels were produced by rusted wheat plants. The plump wheat kernels were produced by healthy wheat plants

Great as are the changes in the ways of harvesting, the harvest itself causes happiness to-day, as it has during all the thousands of years since the first harvest of all.

In England, when the old-time harvesters brought home the last sheaves of the season, some of the girls, in bright dresses, rode in the carts, and the other reapers danced to the music of pipes and sang:

We have plowed, we have sowed,
We have reaped, we have mowed,
We have brought home every load,
Hip, hip, hip, harvest home!

A good harvest is so important to people that for centuries in many lands it has been thought fitting to celebrate the close of the season in some happy manner such as a "feast of the ingathering at the end of the year." Our own national harvest festival is the legal holiday known as Thanksgiving Day.

All this rejoicing rests on the welfare of the frail grasslike grain plants. If the plants are healthy, the crop is good. If the plants are sick, they produce shrunken or worthless kernels. (Fig. 7.) Thus we can understand that the time of harvest may be the saddest season of the year instead of the gladdest. If the grain is a failure, all the work and the cost of the crop and all the waiting and hoping have gone for nothing. Instead of feasting, there is hunger.

There have been many such grievous harvests in many lands, for often the wheat would sicken and be unable to grow kernels fit for flour. Long ago such sickness of the wheat was called mildew. In ancient days the Romans held a festival in April and offered sacrifices with a ceremony that they hoped would protect their fields from mildew. In one of Shakespeare's plays we read that " The foul fiend Flibbertigibbet mildews the white wheat."

We have this same disease of wheat in America. We do not call it mildew now. We call it black stem rust, the fungus which lives part of its life on the barberry from which it spreads to grasses and grains.

Every year some areas of wheat (and such other valuable grains as oats, barley, and rye) are stricken with black stem rust. For a long time now this dreadful disease has ruined millions of bushels of wheat in the United States every year. One year, during the World War, when the farmers were trying to grow more wheat than usual to make bread for the soldiers, there was an epidemic of this terrible rust of wheat which destroyed hundreds of millions of bushels.

This situation is serious for the grain farmers. Indeed, some farmers have become discouraged about growing wheat because it is so likely to be spoiled by the rust.

If less wheat is harvested, fewer plows and harrows and seeders and reapers will be needed, and there will be less work for the men who make such farm machinery.

If less wheat is harvested, fewer trains and ships will be needed to carry the crop from the fields to the mills; and, of course, there will be less work for men on trains and ships.

If less wheat comes to the mills, what will that mean to the millers and other people in such great milling centers as Minneapolis, where now hundreds of thousands of barrels of flour are ground each week?

If less flour comes out of the mills, less cotton will be needed for cloth sacks and less lumber for barrels and less pulpwood for paper bags and boxes, and so the cotton grower and the lumberman will suffer.

Thus you can see that it is not the farmer alone who has a fearful enemy in the barberry that carries the rust with its spores blowing over his wheat fields. Indeed, you might try to see if you can think of any business that is not somehow affected by the wheat crop and by the welfare of the people who work, directly or indirectly, with wheat.

Of course you do not need to be reminded that less flour means less bread and muffins and macaroni and cookies and cakes and pies. You may be surprised, however, to learn how many other foods need flour to make them good. A cookbook in common use in the United States during the past 30 years contains more than 1,000 recipes that call for the use of flour or of something made with flour. Many a dish of meat or vegetables is better to taste and to look at, as well as better in food value, because it has been rolled in bread crumbs or thickened with flour or served on toast or otherwise combined with the ground powder of the wheat seed.

The grave danger which threatens our food supply and business of many sorts would be unspeakably terrifying if there were nothing we could do to save the wheat. Fortunately, however, there is one thing we can do. We can control the rust in the Northern States by destroying the common barberry.

Farmers in England and in certain countries of continental Europe started the fight against the barberry many years ago. Some of them saw that when the winds blew across the barberry hedges and then over their grainfields the grain on that side of the hedge would be blighted with rust. So they dug out the hedges and watched their grain, and found, in the following year, that the plants were healthy and the kernels plump and sound. But taking out hedges was not enough to cure some fields, because most of the rich landlords had barberry bushes in their grounds and the grain nearest such bushes would be blighted when the weather was warm and moist. The farmers asked the landlords to dig out their barberry bushes, and some of the landlords did; but others thought it a silly notion that a barberry bush could harm a grainfield, so they refused. Then the farmers went away angry and came back again in the dark with axes and chopped out the barberry bushes, or they brought kettles of scalding water and killed them that way. They were desperate because they and their families would starve if they could not grow good grain.

It was a bitter and angry sort of fight because no one understood just what the cause of the trouble was. The farmers found that they could not grow good grain near barberry bushes, but they did not know why. So they tried to think of a reason. Some of them said that the barberry blossoms blighted the wheat. Others said the breath of the bushes spoiled their grain. Such explanations seemed silly to people who liked the barberry bushes. Of course you know that was in the days when people were very ignorant about the growth and habits of plants. But they were not dull. They knew by watching and trying that grain would be spoiled if barberry bushes were growing near, and that if they took away the barberries they could have good grain. So they kept fighting the barberry (and sometimes the men who planted it) even when they were laughed at.

As the knowledge of science increased, the plant doctors began to study the cluster-cup rust on the barberry to see if it really could have anything to do with the rust that looked so different on the wheat. And so it happens now that no one laughs at those sturdy old farmers for insisting that the barberry was to blame for the rusted grain crops. For, when the scientists found why the barberry was a bad neighbor for a wheat field, as you learned at the beginning of this story, they were ready to stand by the farmers and join the war against the barberries.

Nowadays there is no mystery about the barberry story. We know that the spores from the cluster cups on the barberry bushes blow for miles across the grainfields, doing dreadful damage all the way. And knowing this, we know, of course, how to prevent such damage. To cure the wheat of black stem rust in all parts of the world where the winters are cold enough to kill the summer or red stage of the rust, the only thing that need be done is to get rid of the barberry bushes on which the cluster cups grow in the spring. That is exactly what the farmers in England did years ago. More recently, that is what the people of Denmark and some other European countries have done. And everywhere the result is the same: No barberry bushes and good crops of grain!

In the United States, the hardest struggle against the barberry is going on in that part of the country where the loss of wheat has been greatest. This battlefield covers an area more than 1,500 miles long and 700 miles wide. In it are the States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming.

The people who have been doing the fighting are workers from the United States Department of Agriculture, the State colleges of agriculture, the State departments of agriculture, farmers, business men, nurserymen, newspapermen, teachers, and many others.

Millions and millions of barberry bushes have been found and killed, but unknown thousands of bushes have still escaped capture. Big bushes in dooryards and hedgerows and along roadsides are easy to find, but small bushes miles away in the woods or in unused fields, or lost among taller plants or hidden in some river-bank shelter, are hard, very hard, to find. It is in such far-away places that barberry seeds have been scattered by birds and other animals during a hundred years and more. Hunting for the smallest escaped or " wild " bushes seems like hunting for needles in haystacks.

But there is a zest in hunting that boys and girls like. Their eyes are keen, and they spend much time roaming through fields and woods and climbing banks. So it is not hard to guess why boys and girls are being asked to join in the great hunt for barberry bushes. They are asked to help protect the food for the army of wheat eaters. Scouts are needed for the barberry battle—boy scouts, girl scouts, boys and girls belonging to the 4–H clubs, and boys and girls belonging to no clubs at all.

In fact, help is needed from anyone, young or old, who will do these three things: (1) Learn to know the harmful common barberry and the harmless Japanese barberry; (2) send a sample of any bush you think is a common barberry to your State agricultural college; and (3) tell this story to anybody you find who does not understand about the common barberry and why we should kill it. Let us repeat these three things so we will not forget:

1. Learn to know the harmful common barberry. It has leaves with bristle-toothed edges, gray bark, blossoms in clusters, red berries in bunches, and spines usually in threes. (Fig. 8.) Learn to know the harmless Japanese barberry. It has smooth-edged leaves, brown bark, blossoms and berries singly or in twos, and spines usually single. Japanese barberries have been planted in many yards for ornament, and they do no harm to grain because the rust can not live on them.

2. If you find a common barberry bush growing in any one of the 13 States where the barberry battle is going on, mark the place where you find it. Then cut off a sample (to prove that you know a barberry bush) and send it to the agricultural college of that State with your name and address and a letter telling where you collected the sample. The news you send will help the people in charge of the work to locate the bushes and see that they are destroyed.

3. If you know any person who does not understand why we are fighting the barberry, tell him what you have learned about the life of the black stem rust, or let him read this publication. Even if you are not living in or near any of the 13 States where the barberry battle is raging, you can help. For we must remember that the

trouble all began because people who did not understand what a dreadful thing they were doing planted barberries in new places. So, wherever you live, you can help keep the grass in the nearest meadows or pastures healthy and the grain in the nearest fields in good condition by not allowing any common barberry bushes in your yard, and by telling other people what you know about these pests.

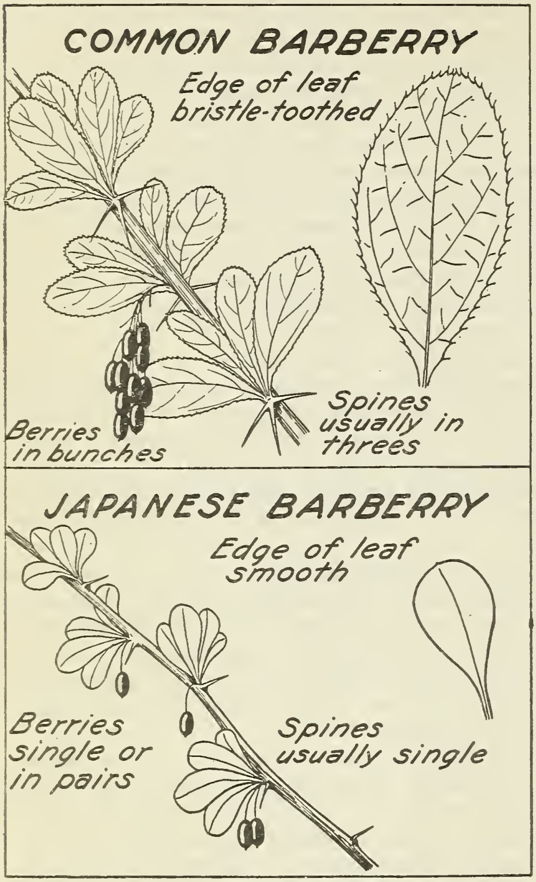

FIG. 8.—Learn to know the common barberry from the harmless Japanese barberry

THE CALL FOR VOLUNTEERS

It is because the older workers have found it a longer, harder battle to kill all the barberries than they at first thought it would be, that they are asking for young volunteers to help them.

If your eyes are keen enough to find a seedling barberry that other volunteers have passed by, enlist as a scout for spying the hidden enemy of wheat.

Choose a captain for your company. Challenge a company from a neighboring school or town to find more barberries in a week or a month than your company can.

Select for your company some bright color, as red or blue or green or yellow, and tie a strip of colored cloth or bit of colored string to every barberry bush you find. Then other volunteers passing that way will know what company has been there before them.

But there is no need to tell you how to do your fighting! If you are patriot enough to join in the great battle to protect wheat and barley and oats and rye, you will think of plenty of ways of winning an exciting and glorious victory.

If you need a slogan, you might try “Bread or Barberries,” unless you can think of a better one. And for a manual you may have, if you like, this publication, which is dedicated to the Defenders of Bread.

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